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(71) Applicant: WESTINGHOUSE ELECTRIC CORPORATION [US/US]; Westinghouse Building, Gateway Center, Pittsburgh, PA 15222 (US).

(72) Inventors: VERCELLOTTI, Leonard, C. ; 830 7th Street, Oakmont, PA 15139 (US). MANDEL, Alan, F. ; 263 Main Entrance Drive, Mt. Lebanon, PA 15228 (US). RAVAS, Richard, J. ; 225 Sunrise Drive R.D. #2, Irwin, PA 15642 (US). SCHLOTTERER, John, C. ; 3479 Ivy Lane, Murrysville, PA 15668 (US). NEUNER, James, A. ; 3914 Hardt Drive, Gibsonia, PA 15044 (US).

(74) Agents: WILLIAMSON, John, K. et al.; Westinghouse Electric Corporation, Law Department, 1310 Beulah Road, Pittsburgh, PA 15235 (US).

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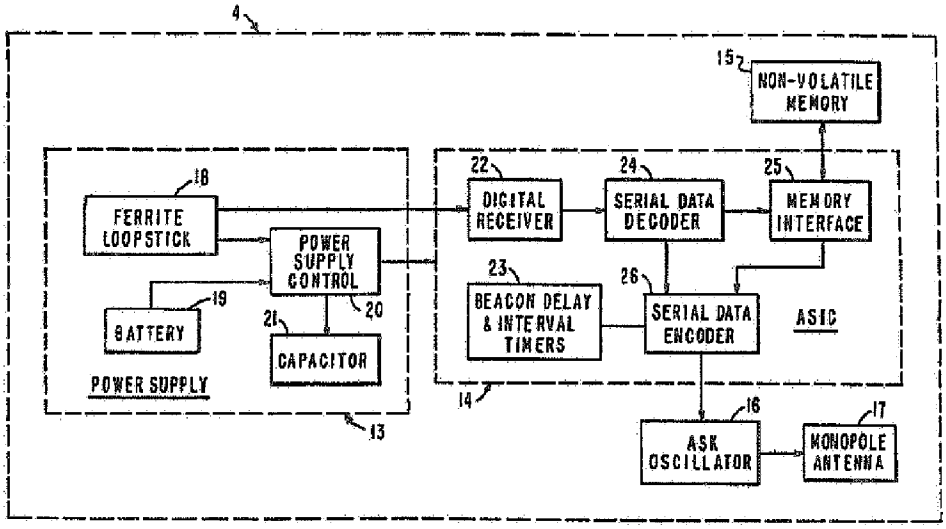

(57) Abstract

A dual mode electronic identification system using a tag which has an RF receiver and transmitter contained therein. In the first mode the tag responds to an interrogation signal by transmitting an identification data to the interrogator. In the second mode the tag periodically transmits an identification beacon signal to a directional sensing antenna which uses the signal to compute the position of the tag. The power supply for the tag operates from an internal battery or from power received from a portal signal via a tag receiving antenna. The battery can be automatically turned off when the tag is in the portal area and the unit can be shifted into the battery operated beacon mode when the tag is removed from the portal area.

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DUAL MODE ELECTRONIC IDENTIFICATION SYSTEM

BACKGROUND OF THE INVENTION

This invention relates to an electronic identification system having a tag which is attached to a person or object for identification purposes. The tag can in a first mode when asked to identify by an interrogation signal communicate via radio frequency with fixed locations to identify the tag, such as at portals, for access control to secured areas, and in a second mode the tag can communicate as a beacon with fixed equipment to provide for identification and corresponding position or tracking of the tag.

The protection and tracking of personnel and property in high security areas continues to be a vexing problem. Airports, government facilities, and industrial sites are increasingly concerned with securing large areas for controlled access. Often times the very areas in which it is desired to restrict access also require a

large number of authorized occupants to gain legitimate access to work areas. Use of guards and screening devices at entrances needs to be complemented by continuous monitoring of personnel once they are on the premises. The use of television cameras and monitors as a solution to this problem suffers from the limitations of human fatigue and the lack of automation to track and distinguish authorized from unauthorized occupants in a secure area. Advanced technology including concepts using laser and infrared signals to track people or objects moving in secured areas provide some help. The need still exists to distinguish authorized from unauthorized persons or objects. While optical means have been suggested for accomplishing such distinguishing of authority, optical means are limited by line-of-sight operation. In addition to tracking and identification of people or objects in a secured area, it is also desirable to restrict entrance into the secured area to those who have proper identity. Access cards and electronic portal admission devices are known and can provide an initial distinguishing of authorized and unauthorized personnel or objects upon access.

An airport location is typical of the complex needs of a modern security site. Portals into the high security runway and baggage areas can be either manned or provided with optical or electronic identity card readers

so as to provide a first line of defense against unauthorized entrance into the larger expanse of the runway and baggage areas. Such single line defense is usually considered inadequate for security purposes, and a further security network will be provided. Infrared, optical, or laser scanning systems can be used to identify persons moving within the wide security area, such as the airfield and baggage areas. Unfortunately in such areas activity of authorized persons cannot be distinguished from the movement of unauthorized persons by such scanning systems. There is a need to identify and distinguish authorized from unauthorized persons in a wide area after admission to the area has been gained through some type of portal security system. If authorized persons can be identified and their positions known, then the positions and locations of the authorized personnel can be removed from the data set of the movement detectors and appropriate security action can be taken with regard to the remaining personnel or objects detected.

Reliable identification is also desired in a warehousing situation where it is desired to identify certain commodities when they enter at a warehouse portal and later to identify the position and identity of commodities in a wide area, such as storage or work areas.

In both the security and commodities identification applications it is desirable that the identification system provide for reliability, low cost, relatively long life of batteries or other power supplies, and small size so as to be convenient in use.

SUMMARY OF THE INVENTION

The invention provides for an identification system using a small identification tag which has both a radio frequency receiver and a radio frequency transmitter associated therewith. The tag operates in two modes that provide for identification of personnel or objects for access control at portals and badge readers, and allows for a wide area mode permitting position tracking of the identification tag. The tag is based on a silicon gate CMOS application-specific integrated-circuit and an eight pin non-volatile RAM chip for memory storage. The use of the non-volatile RAM allows the tag to be batteryless when used for access control through portals or with badge readers. When used in the second mode for a wide area of tracking, a lithium/manganese dioxide battery is provided to supply sufficient power for the transmitter. The non-volatile memory can be depended upon to retain identification and history data while the battery is removed.

In an access mode the tag is used to gain entry or access to a secured area. An interrogation signal used at the portals turns the receiver in the tag on and queries the tag for a proper identification. In this mode the battery supply is not used for transmission of the response signal from the tag. The response signal is transmitted using energy received from the interrogation signal. If the tag is authorized, the response signal during the access interrogation can be used to admit the person or object having the tag and can be recorded in a database so that the system knows the identity of the person or object entering the secured area.

Once in the wide secured area the tag now becomes a radio frequency beacon having transmission powered from its internal battery supply without being queued to respond by an interrogation signal. The beacon signal can provide the identity of the tag and, through use of directional antennas and a position control, the specific location of the authorized identity tag can be known. The location and identity may then be displaced, stored, or used in conjunction with other security systems to provide a more complete informational database. In some applications it may be desirable in the wide area tracking mode to communicate with the tag, and either a separate transmitter or the portal interrogation transmitter can be used to communicate with

the tag. To conserve the battery in the wide area tracking mode, the beacon signal is preferably a periodic burst transmission. When the tag leaves the wide security area via a portal the beacon signal is turned off by the portal interrogation signal which also removes the battery supply from operation. The interrogation signal can be broadcast continuously so that the tag will be powered when it is in the portal area without having to resort to using the battery. The interrogation signal may have modulation that is coded into the signal and can be periodically sent to request the tag to identify itself.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1A is a diagrammatic representation of a security system using a tag at a access portal.

Figure 1B is a diagrammatic representation of a security system using an identification tag as a beacon for position tracking in a wide security area.

Figure 2 is a block diagram of a presently preferred embodiment of a dual mode electronic identification tag.

DESCRIPTION OF SOME PRESENTLY PREFERRED EMBODIMENTS

The present invention may be used for a number of applications in which an identification is required at a fixed position as the tag enters a given area and where the identification and location of the tag is desired to be known when the tag is in a much wider varying area.

One presently preferred embodiment of the invention is an application in which the tag is used in a security environment, and the tag is used as a personnel identification device. Other applications could be used in situations where the tag is placed on vehicles, commodities, or containers so that they may be identified as they enter a given area and then tracked in a larger area.

In Figure 1A a portal, such as a doorway 1, is shown which normally provides an access through a boundary or security line into a wider area. An authorized personnel 3 has in his possession a dual mode identification tag 4. The tag may be in the form of a badge, photo ID, or other visual credentials. The tag incorporates a radio frequency transmitter and receiver as shown in Figure 2. Upon approaching the portal 1 the tag 4 comes within the signal range of a portal head 2 which emits an interrogation signal which is received by the tag 4. The tag will respond to the interrogation signal by giving coded information to the portal head 2

which will identify it as an authorized tag. The radio frequency transmitted from the tag 4 is received by the portal head 2, and the portal head 2 may use known controls to admit the authorized personnel 3, and, in some applications, it may record the data into a display or data logging system.

Figure 1B shows the authorized personnel 3 after he has entered the wide security area through a portal. In this mode the tag 4 emits a periodic radio frequency beacon signal which is received by directional antennas 5 and 6. The beacon signal emitted from tag 4 provides an encoded identity information, and the rotational scanning antennas 5 and 6 provide the identity information and the angular position information to a position control 7 which includes a receiver 8 and a decoder 9. The decoder now contains both the information as to the identity of the tag 4 and its relative position from the scanning antennas 5 and 6. This information can be stored or displayed on a display 10 such as a CRT terminal.

The choice of radio frequencies for transmitting and receiving in the tag identification system is important. A low RF frequency such as 150 kHz can be used for the interrogation signal at the portals 1. This low frequency lends itself to simple ferrite loopstick antennas mounted above the portals, such as the head 2. Since metallic door jams may interfere and tag alignment

on personnel 3 cannot be guaranteed, a pair of ferrite loopsticks with appropriate phase shifting can be used to provide a more uniform field pattern. The field used will be the near magnetic field, which can be received for both energy and power by a miniature ferrite loopstick 18 mounted in the tag. The ferrite loopstick 18 in the tag provides greatly improved efficiency over printed circuit coils that are sometimes used. The advantage of the near magnetic field is that it falls off as the distance from the loopstick is cubed, thereby reducing the potential for interference between consecutive multiple portals.

The low frequency from the portal head transmitter 2 is broadcast continuously so that the tags can be efficiently powered. The modulation can be differential phase shift keyed at 9600 baud so that communications can be completed rapidly. This choice of modulation method is chosen to provide accurate signal demodulation and bit decoding in the tag without the need for crystal controlled references. The low frequency interrogation signal is received at the tag 4 by the ferrite loopstick 18. The loopstick 18 is part of the power supply 13, which also includes a battery, such as a lithium/manganese dioxide battery which is used in the beacon mode. During the access mode the loopstick 18 receives the interrogation signal and provides a signal

to the power supply control 20 which charges the capacitor 21 and controls the battery 19 to place it in an off condition.

The tag 4 also includes a silicon gate CMOS application specific integrated circuit 14. The integrated circuit 14 includes a digital receiver 22 which receives signal and power in the first mode from the loopstick 18. During the access mode the loopstick 18 provides power to all devices in the tag including the transmitter. The digital receiver 22 processes the interrogation signal and a serial data decoder 24 extracts the identity information from the interrogation signal. The request to respond prompts the decoder 24 to retrieve its identity information from non-volatile memory 15. The non-volatile memory may be a RAM chip, such as one containing 128 bytes of storage. Such RAM chips are readily available and may easily be used with a memory interface 25 on integrated circuit 14. The memory chip 15 has previously been programmed with an identity number which is transferred via the memory interface 25 and serial encoder 26 upon receipt of an interrogation signal.

The serial data encoder 26 receives the information to be transmitted from the memory interface 25 and the request to respond from the serial data decoder 24. The encoder 26 when cued from an

interrogation signal from the portal head 2 keys the identity or authorization data to the amplitude shift keyed oscillator 16 which feeds a monopole antenna 17. The oscillator 16 and antenna 17 form a UHF radio frequency transmitter. This transmitter operates at an ultra-high frequency such as 950 MHz. This frequency lends itself to a simple single transistor oscillator circuit and a quarter-wave monopole antenna which is approximately 3.1 inches in length. These features are very desirable when packaging the tag for personnel use. The response signal from antenna 17 is read by the portal head 2 and the information received from the tag can then be processed.

In the wide area beacon mode the beacon signal from the tag 4 is supplied by the oscillator 16 and antenna 17. In this mode the burst transmissions can be selectively turned on when the tag leaves the portal area and enters the security area. Conversely, the burst mode transmissions can be turned off when entering the building through an entrance portal. The ferrite loopstick 18 when not in range of the low frequency interrogation signal emanating from the portal head 2 cannot supply power to the power control 20 which functions as a diode auctioning device to power the unit from the available electric power source, either the capacitor 21 or the battery 19 or the energy from the

loopstick 18 itself. When the stored energy from the interrogation signal is not available, power is supplied from the battery 19 to the integrated circuit 14 and other devices located on the tag 4. In this mode when energy is being supplied from the battery the beacon signals from the tag are not continuous but contained in transmission bursts. The transmitter is used in a burst mode at low duty cycle, for example .0025, for the wide area beacon signal mode. Typical operation is a 500 microsecond burst of data 5 times per second. The timer 23 prompts the encoder 26 to key the oscillator 16 in this mode.

In one presently preferred embodiment the timer 14 is a random timer device which reduces the probability of multiple tags transmitting simultaneously and the signals interferring with each other. Timer 23 can have an output of a random frequency between predetermined limits. These limits may vary from a fraction of a second to several hours depending upon the number of tags in the system, and the time needed to recognize and identify the beacon signal. When in the beacon or tracking mode the transmission bursts from tag 4 are sensed by scanning antennas 5 and 6 that can recognize the code bursts. Control 7 is then used to home in on the angular location of the tag. Stepping motors used in conjunction with antennas 5 and 6 can be used to look for

the maximum field strength. Antenna rotation scan rates of one rotation per two seconds will encounter up to ten burst per transmission to enable rapid location of tag beacon signals. The coordination of the angular position from two consecutive scanning antennas will yield location of tags along with the identification data related to that tag. At 950 MHz the scanning antennas can be very small, seven element Yagi's are approximately 12 inches in length with approximately 6 inch elements.

The tag 4 uses the same UHF burst transmission for the wide area position beacon mode and for the identity access interrogation mode at portals and badge readers. Normally the beacon transmitter in the tag is turned off when it is in the area of the portal in the unsecured area. It is turned on usually in response to an interrogation signal at a portal and then powered by the loopstick antenna 18 circuit. If it leaves the field of the portal the loopstick 18 power is diminished and the tag 4 is powered by battery 19 and automatically is placed in the beacon mode with interval timer 23 initiating identification data transmissions through the keyed oscillator 16 and antenna 17. This automatic shift in power supply source is an important feature in the power supply management of the tag design. Battery life of 1 to 3 years is anticipated with a 500 mAh lithium cell 19.

This invention provides a single device which can function as an access identification means and as a wide area position location and identification beacon. Simultaneous with the shift in modes is a shift in the respective source of electrical power for the respective mode operation. In one embodiment the interrogation signal emitted by the portal head 2 is coded into a continuous RF signal the presence of the continuous RF signal causes the battery to be turned off.

In one presently preferred embodiment where the tag is used as an inventory tracking device, the activation of the beacon is controlled by a timer. If the tag's beacon delay timer is set for a given period of time, then it will begin beacon operation at the expiration of that period. When the timer reaches its preset, the tag 4 will generate via the oscillatory 16 and antenna 17 a beacon signal that will identify the tag. As with previous embodiments in the beacon mode, this signal is powered by battery 19. In this embodiment timer 23 can have both a random output and a preselected output. When the preselected time period has expired and the tag has not been asked for an inquiry via a signal to loopstick antenna 18, then the serial data encoder 26 sends a desired data transmission to the oscillatory 16. This mode is particularly advantageous in warehousing situations where the tags are associated with goods that

may be dated or aged and it is desirable to select the preset time to correspond to the maximum desired dwell time in the warehousing system. If the tag and the goods to which it is attached has not been moved to a portal or inquired to via an interrogation signal for a period equal to this preselected time then the becon delay of timer 23 would enable beacon operation thereby signalling its presence and identity. By monitoring this beacon mode signal, aged or dated articles in the warehousing system can be quickly identified. In addition since the beacon signal would normally be positioned trackable, the identity and specific location of "stale" items in the system can readily be self-identified. Timer 23 can include a beacon interval timer for setting the period between transmission bursts, and a delay timer which sets the time period for beginning or initiating the beacon signal.

While certain presently preferred embodiments have been described and shown in the figures, other embodiments of the present invention will be apparent to those skilled in the art.

CLAIMS:

1. A dual mode electronic identification system comprising:

an access transmitter means for providing an RF interrogation signal;

an access receiver means for responding to an RF tag signal having identifying data encoded therein;

at least one electronic identification tag having supply means for providing electrical power to said tag, memory means for storing identifying data associated with said tag, RF receiver means powered by said supply means for processing an interrogation signal, RF transmitter means for transmitting identifying data stored in said memory means in response to the receipt by said receiver means of an interrogation signal having a request encoded in said interrogation signal and for periodically transmitting a beacon signal having identifying data as stored in said memory means encoded into said beacon signal when an interrogation signal is not received by said receiver; and

beacon signal processing means for detecting said beacon signal and determining the position of said tag from the relative values of said beacon signal and decoding said identifying data from said beacon signal.

2. The dual mode electronic identification system of claim 1 wherein said beacon signal processing means includes at least two direction sensing antennas.

3. The dual mode electronic identification system of claim 1 further comprising means for displaying the position and identification data of said at least one identification tag from information processes by said beacon signal processing means.

4. The dual mode electronic identification system of claim 1 wherein said beacon signal processing means compares the information received from said beacon signal with other data and only displays that position information from said other information that does not correspond to position information from identified beacon signals.

5. The dual mode electronic identification system of claim 1 wherein said access transmitter broadcasts a signal continuously and periodically encodes information on said signal requesting said tag to respond.

6. The dual mode electronic identification system of claim 1 wherein said beacon signal processing means includes communication means for transmitting information to said tags that are recognized by said beacon processing means.

7. The dual mode electronic identification system of claim 1 wherein said supply means further includes:

a first means for supplying power from an electrical storage battery; and

a second means for supplying power from an RF signal.

8. The dual mode electronic identification system of claim 7 wherein said second supply means further includes a sensor for inductively converting said RF signal to a source of electrical current.

9. The dual mode electronic identification system of claim 8 wherein said sensor is also connected to said receiver means and said RF signal is said interrogation signal.

10. The dual mode electronic identification system of claim 7 further comprising:

a power supply control means for utilizing said second means when a given RF signal is present and for utilizing said first means when said RF signal is not present.

11. The dual mode electronic identification system of claim 10 wherein said RF signal is said interrogation signal.

12. The dual mode electronic identification system of claim 11 wherein said second means includes a sensor for inductively converting said interrogation signal to a source of electrical current.

13. The dual mode electronic identification system of claim 10 wherein said periodically transmitting is controlled by a timer having an output at random time delays between predetermined limits.

14. The dual mode electronic identification system of claim 1 wherein said periodically transmitting is controlled by a timer.

15. The dual mode electronic identification system of claim 1 wherein said periodically transmitting is controlled by a timer having an output at random time delays between predetermined limits.

16. A dual mode electronic identification tag comprising:

supply means for providing electrical power to said tag;

memory means for storing identifying data associated with said tag;

RF receiver means powered by said supply means for processing an interrogation signal; and

RF transmitter means for transmitting identifying data stored in said memory means in response to the receipt by said receiver means of an interrogation signal having a request encoded in said interrogation signal and for periodically transmitting a beacon signal having identifying data as stored in said memory means encoded into said beacon signal when an interrogation signal is not received by said receiver.

17. The dual mode electronic identification tag of claim 16 wherein said supply means further includes:

a first means for supplying power from an electrical storage battery; and

a second means for supplying power from an RF signal.

18. The dual mode electronic identification tag of claim 17 wherein said second supply means further includes a sensor for inductively converting said RF signal to a source of electrical power.

19. The dual mode electronic identification tag of claim 18 wherein said sensor is a ferrite loopstick.

20. The dual mode electronic identification tag of claim 18 wherein said sensor is also connected to said receiver means and said RF signal is said interrogation signal.

21. The dual mode electronic identification tag of claim 17 further comprising a power supply control means for utilizing said second means when a given RF signal is present and for utilizing said first means when said RF signal is not present.

22. The dual mode electronic identification tag of claim 21 wherein said RF signal is said interrogation signal.

23. The dual mode electronic identification tag of claim 22 wherein said second means includes a sensor for inductively converting said interrogation signal to a source of electrical power.

24. The dual mode electronic identification tag of claim 23 wherein said request is digitally encoded in said interrogation signal and said receiver means is a digital signal receiver.

25. The dual mode electronic identification tag of claim 24 wherein said transmitter means includes a UHF oscillator and said identifying data is modulated by amplitude-shift-keying of said oscillator.

26. The dual mode electronic identification tag of claim 21 wherein said periodically transmitting is controlled by an interval timer having an output at random time delays between predetermined limits.

27. The dual mode electronic identification tag of claim 26 wherein said request is digitally encoded in said interrogation signal and said receiver means is a digital signal receiver.

28. The dual mode electronic identification tag of claim 26 wherein said transmitter means includes a UHF oscillator and said identifying data is modulated by amplitude-shift-keying of said oscillator.

29. The dual mode electronic identification tag of claim 16 wherein the initiation of periodically transmitted beacon signals is controlled by a delay timer.

30. The dual mode electronic identification tag of claim 16 wherein said periodically transmitting is controlled by an interval timer having an output at random time delays between predetermined limits.

31. The dual mode electronic identification tag of claim 30 wherein the initiation of periodically transmitted beacon signals is controlled by a delay timer.

32. The dual mode electronic identification tag of claim 16 wherein said request is digitally encoded in said interrogation signal and said receiver means is a digital signal receiver.

33. The dual mode electronic identification tag of claim 16 wherein said transmitter means includes a UHF oscillator and said identifying data is modulated by amplitude-shift-keying of said oscillator.

34. The dual mode electronic identification system of claim 1 wherein said beacon signal is initiated after a time delay.

35. The dual mode electronic identification system of claim 7 wherein said beacon signal is initiated after a time delay.

36. A dual mode electronic identification tag comprising:

supply means for providing electrical power to said tag;

memory means for storing identification data associated with said tag;

RF receiver means powered by said supply means for processing an interrogation signal; and

RF transmitter means for transmitting identifying data stored in said memory means in response to the receipt by said receiver means of an interrogation signal having a requested encoded in said interrogation signal and for periodically transmitting a beacon signal having identifying data as stored in said memory means encoded into said beacon signal.

37. The dual mode electronic identification tag of claim 36 further comprising a timer means for preselecting a time period for periodically transmitting said beacon signals.

38. The dual mode electronic identification tag of claim 37 wherein said timer means begins timing the preselected period from the receipt by said receiver means of an interrogation signal.

39. The dual mode electronic identification tag of claim 38 further comprising said timing means beginning its preselected time from the receipt of an interrogation signal having a request encoded in said interrogation signal.

40. The dual mode electronic identification tag of claim 37 wherein said timer begins the preselected time period from the termination of an interrogation signal.

41. The dual mode electronic identification tag of claim 36 further comprising a delay timer for initiating the periodically transmitted beacon signal.

42. The dual mode electronic identification tag of claim 37 further comprising a delay timer for initiating the periodically transmitted beacon signal.

43. The dual mode electronic identification tag of claim 40 wherein said timer begins its preselected time period from the termination of an interrogation signal having a request encoded in said interrogation signal.

44. A dual mode electronic identification system comprising:

an access transmitter means for providing an RF interrogation signal;

an access receiver means for responding to an RF tag signal having identifying data encoded therein;

at least one electronic identification tag having supply means for providing electrical power to said tag, memory means for storing identifying data associated with said tag, RF receiver means powered by said supply means for processing an interrogation signal, RF transmitter means for transmitting identifying data stored in said memory means in response to the receipt by said receiver means of an interrogation signal having a request encoded in said interrogation signal and for periodically transmitting a beacon signal having identifying data as stored in said memory means encoded into said beacon signal, and beacon signal processing means for detecting said beacon signal and determining the position of said tag from the relative values of said beacon signal and decoding said identifying data from said beacon signal.

45. The dual mode electronic identification tag of claim 44 further comprising a timer means for preselecting a time period for transmitting said beacon signals.

46. The dual mode electronic identification tag of claim 45 wherein said timer means begins timing the preselected period from the receipt by said receiver means of an interrogation signal.

47. The dual mode electronic identification tag of claim 46 further comprising said timing means beginning its preselected time from the receipt of an interrogation signal having a request encoded in said interrogation signal.

48. The dual mode electronic identification tag of claim 45 wherein said timing means begins the preselected time period from the termination of an interrogation signal.

49. The dual mode electronic identification tag of claim 48 wherein said timing means begins its preselected time period from the termination of an interrogation signal having a request encoded in said interrogation signal.

FIG. 1A

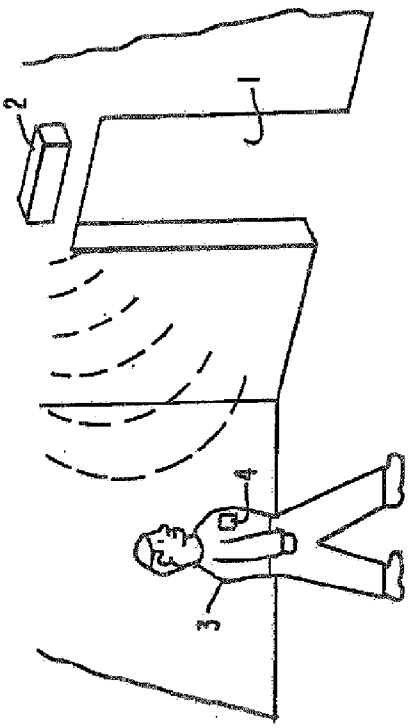
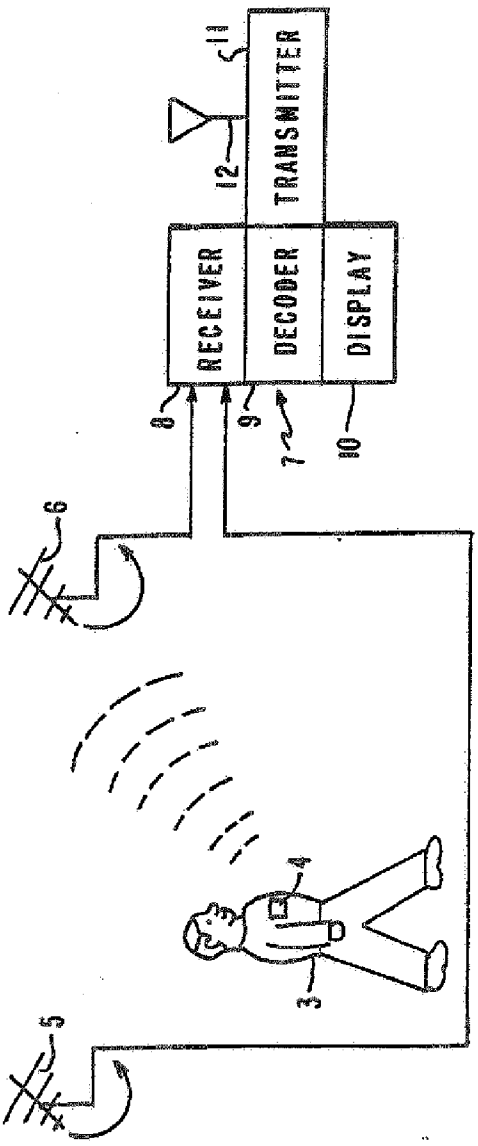

1
2
3
4

FIG. 1B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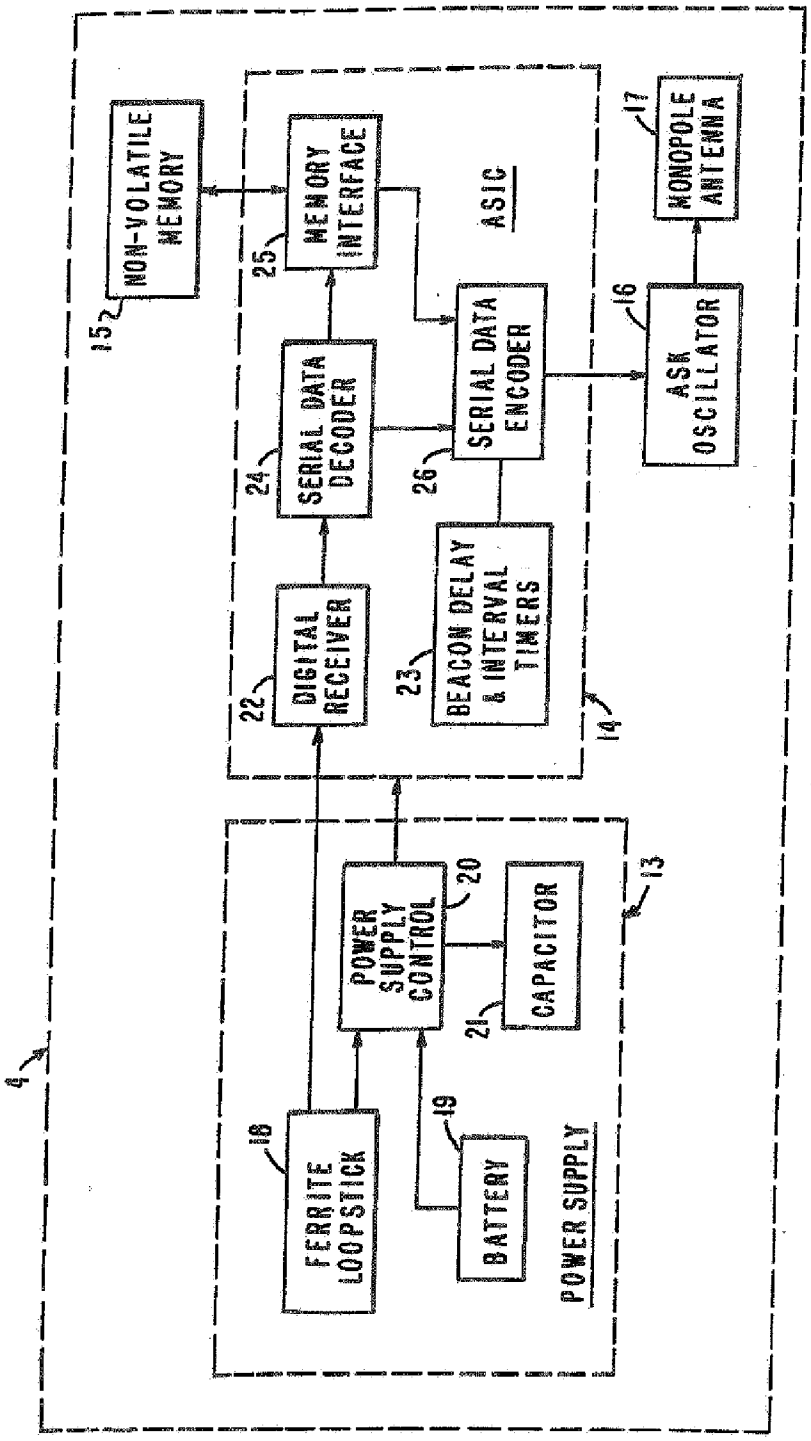
NON-VOLATILE MEMORY
15
MEMORY INTERFACE
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ASIC
MONOPOLE ANTENNA
17
SERIAL DATA DECODER
24
SERIAL DATA ENCODER
26
ASK OSCILLATOR
16
DIGITAL RECEIVER
22
BEACON DELAY & INTERVAL TIMERS
23
14
4
POWER SUPPLY CONTROL
20
CAPACITOR
21
13
FERRITE LOOPSTICK
18
BATTERY
19
POWER SUPPLY

FIG. 2

INTERNATIONAL SEARCH REPORT

International Application No PCT/US 91/08325

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 G01S13/82; G01S5/04; G07C9/00; G06K19/06
G08B3/10

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	G01S ; G07C ; G06K ; G08B

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category[10]	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
X	EP,A,0 245 555 (LO-JACK CORPORATION) 19 November 1987	1-3,5,6, 14-16, 29-32, 34-49
Y		7-9,17, 18,20
A	see page 4, line 20 - page 8, line 21 see page 10, line 5 - page 22, line 3 see page 23, line 4 - page 24, line 18 see page 25, line 12 - page 28, line 5; figures 1-5	10,11, 13,21, 22,24, 26,27

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
21 FEBRUARY 1992	- 4. 03. 92
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	HAFFNER R.D.R.

Form PCT/ISA/210 (second sheet) (January 1985)

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category °	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
Y	EP,A,0 324 564 (SONY CORPORATION) 19 July 1989	7-9,17, 18,20
A	see column 3, line 62 - column 5, line 49 see column 6, line 57 - column 7, line 38; figures 1-4,6	10,12, 21,23
X	US,A,4 177 466 (REAGAN) 4 December 1979	1,2,16, 36,44
A	see column 1, line 53 - column 4, line 20; figure 1	7,10,17, 21
A	GB,A,2 207 787 (BARKER) 8 February 1989	1,2,16, 36,44

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. US 9108325 SA 53571

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 21/02/92
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP-A-0245555	19-11-87	US-A- 4818998	04-04-89
		JP-A- 62277579	02-12-87
		US-A- 4908629	13-03-90
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		JP-A- 1185473	25-07-89
		AU-A- 2775089	20-07-89
US-A-4177466	04-12-79	None	
GB-A-2207787	08-02-89	None	